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ISRAEL AND THE WMD THREAT: LESSONS FOR EUROPE

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Having faced a growing threat from the use of weapons of mass destruction (WMD) for the past several decades, Israel has been forced to make counter-proliferation a top national defense priority.(1) It has invested billions of dollars in developing a multi-layered national defense strategy that is arguably the most highly developed of any country on earth. As such, Israel's experience in this field can offer several important lessons (from its mistakes and successes) for European countries that are only now coming under the range of several rogue countries' long-range missile systems, not to mention the growing threat of WMD terrorism

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THE ISRAELI THREAT PERCEPTION

In order to understand what policies Israel has devised and employed in order to counter WMD proliferation, it is imperative to consider the threats Israeli security planners have taken into consideration when formulating these strategies.(2)

The gravity of the situation for Israel lies in a combination of factors that play to Israel's disadvantage. The first factor is the country's small geographic size (just over 20,000 square kilometers) and its small number of highly valuable targets (e.g. three major seaports, one major civilian airport, and four central power stations). This is then compounded by the country's extremely high population density, with two-thirds of its residents living within a 75km radius in three major metropolitan areas.(3) These factors would increase the temptation to actually use WMD, knowing that the consequences of their use could have a major strategic effect, possibly even ending the country's very existence. The country's small size might also persuade an adversary that it is possible to destroy any potential Israeli second-strike capacity with a big enough initial surprise attack.

Secondly, in any conflict, Israel is heavily dependent on a system of calling up reserve solders to reinforce its small standing army. Should one of Israel's adversaries use a WMD in the first few hours of hostilities--and especially if it hit near a mobilization center--it would unquestionably impede any efficient mobilization of the reserve forces. An attack on its airforce bases could be similarly disabling.(4)

Lastly, almost every country that Israel might have to confront in war is believed to possess WMD of some sort, many are attempting to enhance their capabilities, and some have directly threatened Israel with their use. Before the war in Iraq, security planners believed the country to be within range of over 1,000 surface-to-surface missiles (SSMs), mostly Scuds that can be armed with non-conventional--mainly chemical--warheads.(5) Even worse, most of these missiles would be fired from mobile launchers, which (as the 1991 Gulf War demonstrated) are much more difficult to eliminate than fixed launchers.(6) While many of the following estimates have been amended lately as new information has come to light, a consideration of what

Israeli policymakers believed were the WMD threats the country faced is important in understanding why they chose to pursue the policies they did.

Starting closest to Israel's borders, Syria is considered to have an advanced chemical weapons program (capable of producing sarin and VX nerve gas) and a small biological weapons program. Syria can deliver these weapons via air-dropped bombs or Scud-B, -C, and eventually -D missiles--the last having a range covering all of Israel's territory, even from Syria's northeast corner.(7) To Israel's south, Egypt was the first country in the region to obtain and use WMD (using mustard gas in Yemen), and it is still believed to possess a significant chemical weapons (CW) program and is suspected of also possessing a small biological weapons (BW) program, as well as Scud-B, Project T, and possibly even Scud-C missiles for delivery.(8)

Looking further afield, Libya and Saudi Arabia each have pursued small, but not insignificant WMD programs. While it possesses anywhere from 40-60 CSS-2 medium-range missiles (with the longest range of any missile force in the region),(9) Saudi Arabia is not thought to possess nuclear, chemical, or biological weapons at present.(10) Before it admitted to the extent of its proliferation activities, most observers considered Libya's WMD program tiny and rudimentary compared with those of any of the other major regional actors.(11) For this reason few took seriously Israeli Prime Minister Ariel Sharon's comments in October 2003 that "One would not be surprised if Libya would be the first Arab country [to] have nuclear weapons."(12) However, when Libya revealed everything in its possession two months later, Libya's progress towards a nuclear weapon was much more substantial than previously suspected, and did indeed fall in line with the prime minister's comment. Similarly, by the end of the decade the Libyan program, with cooperation from North Korea, was on its way to producing 50-100 long-range ballistic missiles capable of hitting Israel and most of Europe.(13) Nevertheless, while Libya did possess advanced designs for nuclear weapons and several undeclared sites whose purpose was to create nuclear weapons-grade material, the country was extremely dependent on foreign suppliers, and at the very earliest, was several years away from producing an indigenous nuclear device.(14)

Still, the threats that have concerned Israel most have been from Iraq and Iran. While today's pundits claim that Saddam Husayn's WMD was all a figment of the Bush Administration's imagination, after the Gulf War in 1991, the situation was exactly the opposite: UNSCOM and International Atomic Energy Agency (IAEA) inspectors were surprised by exactly how far advanced the Iraqi programs were. The Iraqi nuclear effort was especially noteworthy for its immense size, financial and human resources investment, multi-directional approach, and that despite all of the above, it was chiefly able to remain undetected by Western intelligence throughout the 1980s.(15) With this experience in mind, and with the knowledge of what technical progress the Iraqis had made, almost all assessments throughout the 1990s believed that without intrusive inspections, Iraq could have a nuclear weapon within a few years; if they obtained highly enriched uranium from abroad, that time was thought to be under a year.(16)

Iraq admitted to creating about a dozen biological agents in vast quantities, most importantly 8,500 liters of anthrax.(17) Reportedly, Iraq even weaponized about 25 surface-to-surface missile warheads and 166 air bombs with BW agents.(18) This amount, as Richard Butler (former head of UNSCOM) claimed, was enough to "blow away Tel Aviv."(19) In addition to mustard, sarin, soman, and tabun gas, Iraq's CW program had also developed 3.5 tons of VX nerve agent (of which a single droplet can be lethal within minutes), beginning as early as 1985.(20)

In April 1990, not only did Iraq test flight its Scud missile with a chemical warhead, but Saddam gave a speech where

he admitted to possessing binary chemical weapons and threatening that, "By God, we will make fire eat up half of Israel if it tries [anything] against Iraq."(21) Having used chemical weapons without hesitation in his war against Iran and against the Kurds in 1988, these were not considered empty threats. With all this in mind, it is easy to understand why Israelis panicked as Saddam fired 39 Scuds at the country only eight months after his overt threat, and why that crisis caused the country to begin investing enormous sums to counter such a threat in the future. In fact, without Saddam even using one chemical or biological weapon and with only 8 of 39 missiles actually hitting populated areas, Israel still suffered two direct deaths, 230 wounded, of them one seriously, nine moderately, and 60 were hospitalized. Indirectly, 4 died of heart attacks, seven died from suffocation due to improper use of their gas masks, 226 people injected themselves with atrophine, and 539 suffered from shock and anxiety. The total financial losses to property were estimated at roughly $40 million.(22)

While Israel can now consider the Iraqi threat to have been eliminated (at least for the foreseeable future), the Iranian threat has only worsened. Recent Iranian admissions to the IAEA have given credence to the claims of Iran's critics that it has been developing a crash nuclear program despite its NPT obligations; and indeed, Iran appears to be following the Iraqi model of diversifying its nuclear sites as well as its enrichment and reprocessing methods.(23) Recent Israeli intelligence assessments see Iran deploying nuclear warheads no later than 2006.(24)

Even without Iran obtaining nuclear weapons, it is already considered to have one of the largest CW programs in the Third World--with several thousand tons of sulfur mustard, phosgene, and cyanide agents in stock and a capacity to produce an additional 1,000 tons of these agents each year. Moreover, Iran has weaponized these agents, putting them into artillery mortars, rockets, aerial bombs, and possibly even Scud warheads.(25) Iran is also considered to possess a small BW program that may be capable of producing small quantities of agent.(26)

While Iran reasonably claimed it needed these weapons in order to deter future Iraqi WMD use, what makes Iran's WMD development so worrisome is its intensely resolute efforts to obtain missiles with ranges far beyond any target in Iraq. In addition to its fleet of Scuds, Iran has also been developing several medium range ballistic missiles, including the Shihab-3 (range 1300km, 700kg payload), Shihab-4 (estimated range 2000km, 1000kg payload), and Shihab-5 (estimated range 5,500km), all of which have been developed with the aid of North Korean, Chinese, and Russian technology.(27) The Shihab-3 has not only been tested nearly a dozen times (though some tests were failures), but Israel believes that Iran also has one to two dozen missiles that are currently operational.(28)

It is important to note that Israel was not necessarily the primary reason why these countries developed or acquired WMD or missile delivery systems, and so it is difficult to claim that this alarming situation is all the result of a prisoners dilemma whereby Israel's actions have caused its adversaries to seek WMD. For example, Iran's main reason has been its experience during its eight-year war with Iraq, in which it was hit mercilessly by Iraqi chemical weapons. Today, a prime rationale is its concern about the United States.(29) Iraq and Saudi Arabia have pursued WMD in order to deter the more populous Iran. When Egypt deployed CW, it did so in Yemen, not in the Sinai. The problem is that even if the primary motivating spark was not Israel, it is all too convenient to add Israel onto these countries' lists of threats their WMD is meant to counter once they have made the decision to acquire these weapons. In fact, should a comprehensive Arab-Israeli settlement come along, it is highly doubtful that any country will roll back its WMD programs, because distrust is the common denominator amongst countries in the Middle East.

The last element of Israel's threat perception is the threat of WMD terrorism, either by Palestinians or al-Qa'ida operatives--a threat which has grown significantly during the past decade. While there is no unclassified evidence that the Palestinians have taken active steps towards procuring WMD, the thought has at least crossed their minds. In March 2003, one captured Fatah terrorist told his interrogators that among the attacks his cell had planned to carry out, one involved using an explosive device that would disperse HIV-infected blood. However, for technical reasons, such an attack would clearly not have been very successful, and the IDF and Shin Bet security services both agreed that the plan had not reached a stage where it could have been practically implemented.(30)

Another example of the potential for Palestinian WMD terror occurred in August 2001, when Tawfiq Abu Khosa, Deputy Chairman of the Palestinian Center for Information Sources in Gaza, published an article in the Lebanon-based Palestinian weekly *Al-Manar*, in which he wrote:

> ...serious thinking has begun for a while about developing a Palestinian weapon of deterrence. . . . [Obtaining this weapon's] primary components, whether biological or chemical, is possible without too much effort, let alone the fact that there are hundreds of experts who are capable of handling them and [using] them as weapons of deterrence, thus creating a balance of horror in the equation of the Palestinian-Israeli conflict.
>
> A few bombs or death-carrying devices will be enough, once they are deployed in secluded areas and directed at the Israeli water resources or the Israeli beaches, let alone the markets and the residential centers. [This will be carried out] without explosions, noise, blood, or pictures that are used to serve the Israeli propaganda.(31)

Yet, as Eli Karmon pointed out, this is more a matter of psychological than actual warfare. Biological agents are extremely problematic for terrorist groups to develop and deploy, both because of the danger of infecting oneself and the great difficulty in dispersing the agent. BW has, in fact, only been used twice by terrorists--and even then with very limited achievements.(32) Even the Japanese Aum Shinrikyo cult, which used sarin gas in the Tokyo subway system in 1995 (the only known use of a chemical agent by terrorists), decided to abandon its plans to use biological agents precisely because of the inherent difficulties and risks.(33)

Al-Qa'ida and groups linked to it may be closer to using WMD in terrorist attacks. There is significant evidence that al-Qa'ida successfully developed and tested cyanide and sarin.(34) Still, as John Hamre points out, while many groups may be capable of developing these agents, "the tasks associated with weaponization [of BW or CW] generally go beyond the skill of amateurs."(35) A "dirty" or radiological device would arguably be easier for terrorists to weaponize and use (though harder to transport undetected). By simply detonating conventional explosives wrapped in radiological material, terrorists are able to disperse the radioactive particles over wide areas, causing death, illness, and the contamination of the area. Evidence does, in fact, suggest that terrorists have been moving in this direction. For instance, a Thai national was arrested in Bangkok in June 2003 with 30kg of cesium in his possession. Following the man's arrest, Eliza Mannigham-Buller, head of Britain's MI5 espionage agency, said it is "only a matter of time" until a terrorist attack is perpetrated using a dirty bomb.(36)

ISRAEL'S COUNTER-PROLIFERATION STRATEGY

Israeli policymakers first began to devise a counter-proliferation strategy in the mid-1960s, as it watched its main adversary, Egypt, use CW during the war in

Yemen.(37) By the end of the first Gulf War three decades later, Israel had developed a multi-layered strategy that rested on four pillars: non-proliferation, deterrence, active defensive, and passive (or civil) defense.

Non-Proliferation

The first pillar of Israel's counter-proliferation strategy is to deny its adversaries the opportunity to develop WMD in the first place, or in other words, an active non-proliferation effort. First and foremost, this means constant gathering of intelligence, and when appropriate, sharing this intelligence with other governments or agencies such as UNSCOM or the IAEA in order to increase the diplomatic pressure on these countries or block certain sales or technology transfers. Sometimes Israel will leak intelligence or false intelligence to media outlets in order to bring these programs into the spotlight.(38)

However, Israel is at a disadvantage in this area. On the one hand, it runs the risk of highlighting its own WMD programs and bringing unwanted attention and criticism whenever its adversaries' arsenals are mentioned. On the other hand, because of Israel's general diplomatic isolation, it usually is unable to garner support for UN resolutions of its own.

With such a poor diplomatic hand to play, Israel has also decided it prudent to incorporate an element of pre-emption in its non-proliferation strategy should its diplomatic efforts fail. The most famous Israeli act of pre-emption was the strike on Iraq's Osiraq (Tammuz) nuclear reactor on June 7, 1981 Israel undertook this operation after it failed in its diplomatic efforts to convince France to end its construction of the reactor. Israel had been especially concerned about the reactor's purpose for three reasons: first, with one of the world's largest known oil reserves, Iraq surely did not need nuclear energy. Second, the reactor used highly enriched uranium--necessary for weapons production--instead of alternative reactors that run on low enriched uranium. Third, even a year before the attack, Iraq had declared that it would block any IAEA inspections of its weapons facilities.(39)

In addition to Israeli intelligence concluding that the reactor was designed to produce Hiroshima-sized nuclear devices, Saddam Husayn had explicitly declared (in an attempt to ease Iranian fears) that Israel was the intended target of its future weapon. Knowing that the plant would become operational in September, after which destroying the core would have created massive radioactive fallout over Baghdad and thus would have been politically impossible to hit, Israel decided to strike before the core's scheduled completion in July.(40) Critics would argue, however, that the timing was extremely suspicious as it also came three weeks before Israel's general election, in which Prime Minister Menachem Begin's party was running in an extremely tight race.

Recently, there were stories in the press about supposed Mossad plans to sabotage Iranian nuclear facilities (or alternatively, to have the Israeli Air Force repeat its 1981 bombing operation), hinting that Israel has not abandoned the pre-emption option.(41) Similarly, some accused Israel of sabotaging the Libyan chemical weapons plant when a fire broke out there in 1990, though the fire was later believed to be a Libyan hoax perpetrated to avert an American pre-emptive strike on the plant.

Deterrence

When non-proliferation efforts have failed, the next pillar of defense is establishing a deterrent threat. Deterrence can be defined as using the threat of severe retaliation to convince one's adversary that it would lose more than it would gain by undertaking a certain course of action. Strategies of conventional deterrence have been a cornerstone of Israeli policy since the state's establishment, and in general, have enjoyed a fair degree of success. Yitzhak Rabin once stated Israel's particular deterrence strategy in the following terms:

> If the worst an Arab leader can perceive as happening as a result of a war he initiates is that he will not achieve his goal, then this is insufficient deterrence on Israel's part. Rather, an Arab leader. . . must constantly bear in mind that, should he initiate war, his armed forces will be badly clobbered, along with sensitive targets causing disruption to the local population, and in a way that will endanger his regime. Otherwise, our deterrence will be minimal. . . .
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> What kind of army is required by Israel. . . to fulfill this formulation of deterrence? To be explicit: armed forces with the greatest offensive potential. For if attacked, we must be able to immediately transfer the war to enemy territory, to destroy as much of the aggressor's armed forces as possible, and to pose a credible strategic threat to that country's very regime. . . . Again, the basic strategy of Israel is defensive, to prevent war, to deter from war. Yet, ironically, the best means for preserving the status quo is by possessing this ultimate offensive capability in reserve. . .(42)

When it came to forming a policy to deter Israel's enemies from using WMD, it has followed a similar logic. Israel is thought to have anywhere from 100-400 nuclear weapons (possibly including thermonuclear weapons), mustard and nerve agents, and possibly even a biological weapons program. Israel has also developed an extensive range of delivery systems. Its ballistic missiles include an estimated 50 Jericho-2 missiles (1,500km range and 1,000kg payload, on mobile launchers); 50 Jericho-1 missiles (500km range and 500kg payload); MGM-52 Lance missiles (130km range and 450kg payload); and unconfirmed reports of Jericho-3 program under development using Shavit space launch vehicle technologies (range up to 4,800km and 1000kg payload). Israel also possesses the Delilah, Gabriel-4, and Harpoon cruise missiles (with ranges of 120-400km), and several fighter jets with ranges exceeding 1,000km--most notably the new F-15I, whose range is believed to be 3,500km.(43) Over the past few years, there have also been contradictory reports in the press about whether the new Dolphin submarine has the capability to fire nuclear-tipped missiles.(44)

The other important aspect of Israel's deterrence strategy has been that it has largely left its capabilities and threats opaque. While frequently promising massive retaliation in the event of a WMD strike against it, Israel has never officially said what it has at its disposal to retaliate with, nor has it elaborated specifically how it would retaliate to a WMD strike (e.g. would it use nuclear or chemical weapons in retaliation for a CW strike). One illustration of a typical Israeli warning was given in July 1988 by then-Defense Minister Rabin, as a result of the increasing use of CW by Iraq against Iran and its own Kurds:

> One of our fears is that the Arab world and its leaders might be deluded to believe that the lack of international reaction to the use of missiles and gases gives them some kind of legitimization to use them. They know they should not be deluded to believe that, because it is a whole different ball game when it comes to us. If they are, God forbid, they should know we will hit them back 100 times harder.(45)

If there is one serious problem with Israel's deterrent strategy, it is that Israel has failed to build reinforced silos for its missile fleet, and has instead sufficed with storing both its Jericho-2 missiles and nuclear weapons (both warheads and gravity bombs) in limestone caves that cannot be reinforced. Since the missile site covers an area smaller than 24km-square, it is possible that just a few nuclear-tipped

missiles could neutralize Israel's missile threat and damage the nearby bunkers holding the air force's nuclear gravity bombs.(46) While Israel has most likely found this step unnecessary until today, with Iran on the verge of gaining a nuclear weapon, Israel may now have to reconsider that decision.

Without question, the most difficult period for Israel's deterrence doctrine came with the 1990-1 Gulf War. There are those who have argued that Israeli deterrence suffered as a result of the Gulf War. These arguments are usually focused on the claim that because Israel did not retaliate against the Iraqi Scud attacks, other Arab regimes will now think that they could do likewise without facing Israeli retribution.

This analysis is mistaken on several counts. To begin with, it is critical to point out that in 1990-1, Saddam Husayn fired Scuds at Israel *precisely because* he was hoping that Israel would retaliate as promised. Husayn was following a strategy of escalation vis-a-vis Israel because he believed that Israeli involvement in the war would likely force the coalition to collapse--or at least force its Arab members to desert.(47) Further, it can be argued that the combination of American and Israeli deterrence was effective at preventing Husayn from equipping his Scuds with chemical warheads, as he realized that the price might be a nuclear strike on Baghdad. And while Israel might have retaliated for the conventional missile strike, it was highly unlikely that Israel's conventional retaliation would even be felt given the coalition's massive aerial bombardment then underway. Finally, as the past decade has demonstrated, no Arab regime has become convinced that it could fire ballistic missiles (and especially ones armed with WMD) at Israel without suffering massive retaliation. In other words, they all saw the 1990-1 Gulf War as an exceptional state of affairs.

This said, the Gulf War did expose two unexpected problems with Israel's defense doctrine. First, Israel encountered a similar dilemma to that faced by America's doctrine of "massive retaliation": doomsday weapons cannot be used in retaliation for non-catastrophic blows. In other words, when Saddam struck with conventionally armed ballistic missiles, he made it so Israel could not legitimately respond with its WMD deterrent, which the international community would have considered overkill. Secondly, while normally Israel might have retaliated with a conventional military strike, the Gulf War also created a situation Israeli planners had not taken into account previously: not all conflicts will be solely between Israel and its adversary, but may include complex international alignments that could be greatly affected by any Israeli military action. In effect, there are times when all offensive operations are not politically-feasible options. This, then, is the primary motivation for Israel's focused drive to acquire an effective active defense option.

Active Defensive

Should Israel's adversaries obtain WMD and not be deterred from using them, the third pillar of Israel's strategy is generally referred to as active defensive. This strategy aims to thwart WMD from successfully hitting its intended target.

To begin to define and understand active defense, it is important to begin by noting that while there are many conceivable ways to deliver WMD, most are unlikely to succeed because they are easy to spoil or have short ranges. The three delivery methods that are the most difficult to stop are ballistic missiles, unmanned aerial vehicles (UAVs), and terrorist attack.(48) Policymakers, however, throughout the 1990s frequently forgot the second and third (and likewise dedicate relatively little funds to their defense) when discussing active defense, thus spoke of active defense as equating anti-missile systems--those systems which aim to disable missiles before they reach their targets.

However, improved border control, for instance, is also a form of active defense--and a critical one at that, as it can stop WMD from crossing a country's borders in

order to be used in terror attacks. Many countries have already taken steps to detect radioactive material at border crossings, and the equipment is quite sensitive. For example, in May 1999, Bulgarian customs officials (trained by the U.S.) seized 10 grams of highly enriched uranium.(49) Of course, detecting chemical weapons is much more difficult, and biological weapons even more so, because neither give off radiation and because BW in particular requires only a small quantity to be effective. Israel has been a leader in employing advanced technology at its borders. For several years it has used sophisticated UV equipment to detect conventional bomb-making material (similar to what has been installed in airports after the September 11 attacks), and recently it has begun to use biometrics to identify those entering from the West Bank and Gaza, as well as returning Israeli citizens at Ben Gurion airport.(50)

In terms of missile defense, there are two types.(51) The type that most people are familiar with is the anti-missile missile systems--especially the Patriot and the Arrow. There are, however, about a dozen such systems that are in development, almost all of them by or in cooperation with the United States.(52) The second type of anti-missile system is what is known as Boost Phase Intercept (BPI).

The Patriot

The original Patriot was an air defense system that could track about 100 targets at the same time at distances of up to 90km away. With 5 to 8 launchers and 20-32 interceptor missiles, the Patriot could automatically manage the engagement of 9 targets, sending commands and tracking information to each interceptor missile as they engaged targets.(53) While originally geared to defend against "air-breathing" targets (i.e. aircraft and cruise missiles), with Saddam Husayn threatening to use Scud missiles to deliver WMD payloads, its mission changed in 1990 and the Patriot became the world's first operating anti-theater ballistic missile system.

The Patriot was first deployed in Israel in 1990-1 with its use in the Gulf War, as the U.S. attempted to give its ally some way to deal with the Iraqi missile threat, other than a counterstrike. At first, the system was considered a raving success, as during the 47 engagements over Saudi Arabia and Israel, it was originally claimed to have accomplished 45 hits.(54) Yet, as Theodore Postol, a researcher at MIT would later write, "While the U.S. Army and Raytheon (the Patriot's manufacturer) initially claimed that the Patriot had successfully intercepted all but 4 percent of the Scuds it engaged, further revelations would be quite the opposite." Israelis suggested soon after the war that the real success rate was somewhere between zero and twenty percent.(55)

The U.S. Army would eventually revise its assessment, stating that it was highly confident that 25 percent of Patriot-Scud engagements resulted in warhead kills. Yet, amazingly, for only a little over a third of this number (i.e. 9 percent of the total) did the Army actually have direct evidence of a kill, with the rest relying on radar tracking data that showed the Patriots simply came close enough to the Scuds to potentially destroy them.(56) While no assessment is very reliable (because the Army did not collect performance data during the war),(57) the available evidence does seem to support Postol's contention that the "first wartime experience with tactical ballistic missile defense resulted in what may have been an almost total failure to intercept quite primitive attacking missiles."(58)

Why were the Patriots so ineffective? The first problem is the difficulty of the task of knocking down a missile during descent. On the one hand, the incoming missile (Scud) may be traveling at speeds of 3600 to 4400mph, while the interceptor is also traveling at 3700mph (in the case of the Patriot-2), with a total closing speed of 7300-8100mph. This means that the interception is happening at a thousandth of a second.(59) The Patriot, it appears, was not up to the task: researchers analyzing video following the Gulf War found that the

median minimum miss distance was roughly 600 meters (in order to stand a reasonable chance of success, the miss had to be no more than a few tens of meters).(60)

This problem is compounded ironically by the primitiveness of the Scud, which is based on German V-2 rocket technology.(61) When the Scud-B range was extended by the Iraqis by adding a mid-section to lengthen the missile and give it more fuel, it undermined the structural integrity of the missile, and so they usually broke apart when re-entering the atmosphere (generally at an altitude of 12-18km).(62) Because the Patriot would home in on the incoming missile using surface-based radar (it attempted to intercept at 4-12km altitude), when the Scud would break apart, it would in effect create multiple radar decoys. With the tail end creating a larger radar cross-section than the front end (which contained the warhead), the interceptor generally targeted the wrong piece of missile debris.(63)

Also, by falling apart into so many pieces, the missile was able to spread its damage over a much wider area due to the falling debris. This danger was made even worse, ironically enough, when the Patriot began engaging the Scuds, as its own fragmentation warhead would not destroy the missile as often as it would split it into sections or many additional pieces.(64) In fact, while the Patriot sometimes scored "a hit," it rarely if ever scored "a kill."(65) With a falling 1500-pound missile fuel tank hitting with the velocity of a subcompact automobile dropped from half a kilometer in the air, and with each coke can-sized piece of debris able to penetrate a five-inch-thick piece of concrete, this debris was extremely dangerous. Even a successful Patriot intercept at 5.5km altitude could result in a trail of debris 5km long.(66)

As if this were not enough, another reason for the Patriot increasing damage was that the Patriot itself would occasionally fall back to the ground (and there were usually two or three patriots fired for every Scud), and would frequently still contain burning rocket propellant. When that hit the ground, the detonating rocket fuel and high explosives in the Patriot warhead could "cause greater ground damage than an intact Scud."(67) Reuven Pedatzur interviewed a high-ranking IDF officer who said that four Patriot interceptors impacted in Israel due to a failure in their self-destruct mechanism.(68)

Lastly, the Patriot system was apparently far from bug-free. Originally deployed in 1982 as a defense against aircraft and cruise missiles, the Patriot underwent two significant upgrades before its use in the Gulf War (and would subsequently undergo another massive overhaul thereafter). This new upgrade, the PAC-2, was originally scheduled for delivery in January 1991, but due to the circumstances, was rushed to U.S. forces four months ahead of time.(69) Arguably as a result, the system required three software upgrades during the period preceding Desert Storm (i.e. Desert Shield), and two additional upgrades after hostilities began.(70) These upgrades included corrections to a timing error on the radar--an error which may have caused the failure at Dhahran in which a Scud hit a U.S. barracks, killing 28 U.S. solders and injuring 98 more.(71) In addition, once the war was over, it was discovered that there was a serious miscalculation in the interceptors' warhead fuse--as it was set for the slower speed of a Scud missile and not the faster Iraqi al-Husayn variant. In large part due to these errors, Israeli sources reported no successful intercepts during the course of the war.(72)

In short, while the Patriot was a politically and psychologically useful tool, helping to give countries like Israel, Saudi Arabia, and Turkey some sense of control and a way to fight back against Saddam's Scuds--and indeed, it did help keep Israel out of the war--the system itself was a serious failure. Moreover, its failures pointed out the extreme challenges facing the scientists and engineers who have tried to create an effective missile defense.

PAC-3

Following its failure in the 1991 Gulf War, the Patriot system underwent a major upgrade, and would afterwards be known as the Patriot Advanced Capability-3 (or PAC-3). In addition to several system refinements including its radar, communications system, and remote launch capability, the most important change to the PAC-3 was the introduction of an entirely new, smaller interceptor missile with a hit-to-kill warhead rather than a blast-fragmentation one.(73)

One of the biggest technological challenges the designers had to overcome was creating a reliable hit-to-kill interceptor, which instead of detonating a high-explosive fragmentation warhead near the incoming missile, aims to hit the missile directly. Throughout the 1990s, this technology did not look promising as most of the tests for it failed. However, between 1999 and 2001, the Patriot's hit-to-kill system made significant improvements, and was able to successfully intercept theater ballistic missiles five times, cruise missiles three times, and a remotely piloted F-4 once.(74) This new PAC-3 interceptor, derived from the ERINT (Extended Range Interceptor) missile, has a launch weight one-third its predecessor and can destroy incoming missiles at altitudes of up to 30km, thus giving a defended area (or 'footprint') of 40-60km in diameter.(75)

Still, while its performance has improved, the cost of the system was not cheap. Total costs for PAC-3 development and interceptor purchase (over 1,000 missiles are planned for purchase) are over $10 billion.(76) Moreover, there were not enough of the improved missiles ready for deployment when the 2003 Gulf War occurred, leaving Israel to use the five PAC-2 batteries deployed in the country more as a standard anti-aircraft system than as back-up for the Arrow.(77)

The Arrow

As opposed to the Patriot, the Arrow is a system that from its very beginning was conceived of--and engineered to be--an anti-ballistic missile system. Moreover, it was designed in the aftermath of the 1990-1 Gulf War, and so was able to incorporate the lessons learned from the Patriot's failure. From the outset, with its extended range (the Arrow can intercept missiles 50-90km away), the system can shoot down missiles over the enemy's territory, that of a third country, or at a minimum, over more scarcely populated areas in Israel, thus solving the problem of damage caused from debris and lessening the pressure to ensure warhead destruction. That being said, the Arrow also has much more proven capability than the Patriot in destroying warheads, as demonstrated by a series of tests conducted by the Pentagon's Ballistic Missile Defense Organization using a demi-chemical warhead. In those tests, the Arrow warheads succeeded in destroying all the chemical cargo.(78)

The Green Pine Radar's 500km range is also a very significant improvement over the Patriot, and allows for much better data collection for a missile's incoming flight path calculation and several more minutes to prepare. Additionally, the Arrow was able to overcome the problem of Scuds disintegrating by aiming to intercept them earlier in their flight before they begin to break apart.(79) In case an adversary should deploy planned radar decoys, the Arrow closes in on its target using an infrared sensor.(80) As Uzi Rubin, former head of the project at the Ministry of Defense has said, "The heart of the Arrow's envelope is its ability to intercept Al-Hussein missiles or Scud-C missiles or any other missile with a range of between 550 and 650 kilometers that Iraq may fire. We developed the Arrow in order to deal with such missiles. That is why it was designed. That was the first operational requirement."(81)

What is still a problem for the Arrow, however, is the threat from the Iranian Shihab-3, a missile that travels three to four times faster than the Scud. While Aryeh Herzog, the current head of the Arrow project at the Ministry of Defense, has stated several times that the Arrow is capable of knocking out the Shihab-3, most

outside experts believe it still lacks that capacity. Herzog himself backed down on the claim more recently when he said, "We will continue development [of the Arrow]. We want to achieve capabilities against future threats, such as those being developed in Iran."(82) And indeed, when put to the test against a similar missile in August 2004, the Arrow was unable to knock out the incoming missile.(83)

Lastly, one of the chief flaws in the Patriot system is that its missile battery and radar system are separated by only a few hundred meters. According to Rubin, "When you are talking about a national anti-missile defense system, you must place the radar system in the best possible location and the missile battery where the missiles can be the most effective--and that location is not necessarily close to the radar system."(84)

Therefore, the Arrow was designed so that the intercepting missile batteries are separate from both the radar system and the launch pad control system. The fire-management system, from its base in Palmachim (south of Tel Aviv), activates the two missile batteries at Palmachim and Ein Shemer.(85) This system layout, when combined with the interceptor's much increased range, enables a defense umbrella for a large section of the country with only a small number of missiles batteries.(86) Similar to the Patriot, the command and control system is designed to respond to as many as 14 simultaneous intercepts.(87)

Israel's defense planners deserve considerable credit for having the foresight to see the threat posed by theater ballistic missiles even before the 1990-1 Gulf War, having signed the agreement with the U.S. to produce the Arrow in 1988.(88) It is important to note that when it was first announced, however, the Arrow had many detractors. On the Israeli side, opposition originally came from then Chief of Staff Ehud Barak and then head of the Israel Air Force, Avihu Bin-Nun. Bin Nun saw the project as being too expensive and as flying in the face of Israel's previous counter-proliferation strategy, which relied almost exclusively on deterrence, while Barak thought it would be quicker and cheaper to have the Americans build the radar and command and control.(89)

On the American side the criticism was much harsher, especially because it was paying most of the $1.6 billion dollar cost for development--and there were worries that the cost could go as high as $7 or $10 billion, though the total development cost actually ended up close to the original figure.(90) There were those who saw the system as in competition with other U.S.-made systems (especially Theater High-Altitude Area Defense, or THAAD, which will eventually be faster and able to reach greater ranges and altitude than the Arrow). They also argued that the Arrow is a system the U.S. and its armed forces will never use, and argue that it raises serious issues about transferring sensitive technology that is forbidden under the Missile Technology Control Regime (MTCR).(91)

This criticism was not helped by the fact that the Arrow began with a track record similar to the Patriot. During the initial phase, the tests in August 1990, March 1991, and October 1991 all failed. As a result of these failures, the development timeline was pushed back and an American Failure Analysis Team was sent to Israel to identify the problems. In September 1992, the Arrow test succeeded, but its scope was very limited and did not even include intercepting an incoming missile.(92) As with every other anti-missile system in development during the 1990s, the Arrow has since shown substantial improvement. On September 15, 2000, the Arrow succeeded in its first frontal intercept of a missile aimed at Israel, and indeed, did so against a relatively small incoming test missile.(93) As of August 2004, nine of the last eleven tests were successful, including several other successful intercepts at altitudes up to 330,000 feet (approximately 100km).(94) Most importantly, in a test conducted by the U.S. Defense Department in July 2004, the Arrow succeeded in its first attempt against a live Scud missile.(95)

Which leads to the biggest benefit the Arrow currently has to offer: it is functional and operational today, whereas THAAD will not currently be operational in the U.S. until 2007 or 2008, and the Navy Theater Wide system until 2010.(96) Given Israel's security situation (and this was emphasized by the 2003 Gulf War), waiting another 5-10 years was not an ideal option for Israeli policymakers.

While it has waned, the debate over the Arrow does continue. Its critics' primary claim is that at $3 million an interceptor, it becomes much more expensive to defend than attack, especially when multiple interceptors are fired at each incoming missile.(97) The critics also claim that it is only a matter of time before Arab states will build arsenals that will simply overwhelm the Arrow's capabilities.(98)

There is some truth to this claim. The high cost and low number of interceptors currently in stock is one of the reasons why the command and control system is often run manually, so that interceptors will be spared if the missile will fall harmlessly.(99) In order to solve this problem, Israel Aircraft Industries (IAI) recently signed a deal to jointly produce the interceptors with Boeing in the United States. When that deal goes into effect, it will not only lower the cost of production, but the pace of production will be tripled as well.(100)

At the same time, this picture painted by the Arrow's critics is not entirely accurate. While this arms race is true in theory, in practice, most rogue regimes are not capable of deploying hundreds of missiles. First, as stated above, most fixed launchers would be destroyed very early in a war, and so would at most be able to only launch one missile each. Secondly, although mobile launchers require only 2-4 hours to reload, they must constantly be on the move in order to avoid detection. As a result, it is unlikely that they will be able to fire more than one missile a day.(101) When combined with the fact that each country has relatively few mobile launchers, the idea of an adversary firing an overwhelming barrage of missiles becomes fairly unrealistic. In fact, during the 1991 Gulf War, Iraq managed only once to fire 14 missiles in a day, and its average was actually between 1.5-4.7 missiles fired per day.(102)

There are two other responses to the critics' claim. The first is that just as one could overload a missile defense, it is equally possible to overload an anti-aircraft defense system--this does not make it foolish to invest in anti-aircraft defense. The second response is that the cost of an interceptor is considerably less than the damage that would be caused by a Scud hitting the ground, as demonstrated above.(103)

Still, this does not mean that the Arrow is a perfect system. For example, the Arrow is unable to knock out the Syrians' highly accurate SS-12 missiles. Their short range (about 80 kilometers) and their brief flying time do not give the Arrow enough time to intercept them.(104) It should be noted in response, however, that every system has its limitations, and therefore is used in complement with others. In this case, short-range missiles would be targeted by Patriots or a Tactical High Energy Laser (THEL), a system which uses a deuterium fluoride chemical laser to shoot down rockets at a range of up to 5km.(105)

The most serious problem that remains for the Arrow is how to overcome the many potential countermeasures a ballistic missile can use (such as cooling off warheads, electronic radar jamming, maneuvering warheads, and radar decoys). While as of today there is no evidence that any country in the region has employed these countermeasures,(106) Iran, North Korea, and Syria are suspected of developing a fragmentation or cluster warhead, which would give single missiles the possibility of overwhelming the Arrow's capabilities.(107)

There are two possibilities for dealing with this countermeasure: the first is the development of BPI, and the second is passive defense--both of which are described below.

Boost Phase Interceptors (BPI)

As described above, destroying an incoming ballistic missile upon descent is an extremely difficult technical challenge. Yet, in the minutes after a missile is launched (in what is known as the boost phase), the task of defeating a ballistic missile is in many ways much easier as the missile is large (the booster stage is still attached and the missle has not begun to break apart), slow moving, does not maneuver, and is significantly easier to destroy in a single shot than during decent. The missile is also much easier to track because of the large launch bloom and massive exhaust, and it is easier to confirm missile destruction than warhead destruction. Furthermore, whereas during descent a defensive system must make a direct hit on the target warhead, during ascent it is enough to send interceptor warhead fragments into the target booster fuel tanks, guidance system, or the rocket motor. Also, it is very difficult to build effective countermeasures (such as booster decoys), and shooting down at boost phase overcomes the problem of MIRVs or submunitions. Lastly, by shooting down a missile over enemy territory, any warhead and all of the debris falls back onto the shooter rather than onto the defender's territory.(108)

In general, there are three types of BPI: 1) Airborne Interceptor (ABI), which would fire high-speed interceptors launched from a fighter aircraft or UAV; 2) Airborne Laser (ABL), which uses a high-power laser carried aboard a converted 747-400F; or 3) a space-based laser. While the first two have the potential of becoming operational this decade, the third will take much longer before it is no longer merely science fiction.(109)

ABI would fire a high-speed rocket using a small kinetic-kill vehicle, which would use infrared sensors and airborne radar to home in on the booster (such a radar could track launches up to 500km away). Israel and the U.S. have been jointly developing this type of BPI, using an Israeli built UAV and an interceptor called the Moab, which can travel at 1.4km/sec. A large UAV could carry two ABIs, while another possible variant of this technology would utilize fighter jets, which could carry between 4-8. Global Hawk, a large U.S.-built UAV, can remain in the air for 24 hours at a time, meaning that two such UAVs would be required to maintain 24-hour coverage over a given territory, though this would limit the number of missiles that could be intercepted to one. Fighter jets can maintain combat patrols for 8 hours, so with one back-up in case of maintenance problems, it would take four to maintain similar 24-hour coverage.(110)

Despite the numerous advantages described above, ABI (and BPI in general) suffers from several problems. The biggest problem is that the interceptor must be within range of the launch site at the time of the launch to be effective. As a result, either a fleet of these weapons would need to be on station continually, or advance warning of several hours or days would be needed before an attack.(111) Complicating matters, Dean Wilkening has estimated that ABI's intercept range would eventually be about 135km for Scud-C missiles and 170km for the Shihab-3.(112) With such small ranges, it would require roughly four to six platforms flying simultaneously to cover the entire territory of Iraq, though that number would be greatly lessened if intelligence could identify where launches would likely come from (as was the case in 1991 and 2003).(113)

There are several other drawbacks to the ABI system. Due to its limited range, ABI platforms would most likely need to enter an adversary's airspace in order to be effective. Yet, violating enemy airspace with an armed aircraft before hostilities have begun could escalate the conflict, and even be considered an act of war. Even after the beginning of hostilities, ABI platforms would have to contend with enemy air defenses, though this would likely be a significant problem only at the beginning of hostilities as Israel would

likely disable such air defenses quickly.(114)

Besides ABI, the other major BPI system under development is the Airborne Laser (ABL) (though this is being developed by the United States alone). This system uses a three-megawatt oxygen-iodine laser carried aboard a converted 747-400F, three to four of which would be required to maintain 24-hour coverage. Its advantages over ABI is that its range is estimated to be more than twice as great (470km for a Scud-C) and its ability to knock down a single missile is likely to be near 100 percent. However, compared to ABI, this system is much more vulnerable to countermeasures, such as hardening the missile booster, launching multiple missiles, or even rotating the missile in flight to distribute (and thus lessen) the laser energy.(115)

Currently, the development costs for the ABL prototype alone is $1.6 billion--nearly equal to the entire cost of the Arrow--and total costs over 20 years are estimated at $11 billion.(116) Besides its potential cost, the other reason Israel chose to invest much more heavily in the Arrow instead of ABL or ABI is that while the Arrow has already been operational for a few years, BPI is still very much in the development phase. ABL, for instance, has yet to even be tested and will not be operational until 2007, and maybe even as late as 2014--that is, if it can overcome the significant technical challenges it faces.(117)

Passive (Civil) Defensive

When all else fails, the final pillar of Israel's strategy is passive or civil defense. This strategy has included:

- the development of a Homefront Command
- distribution of gas masks (fitted for infants, children, elderly and handicapped) and atropine to the general population
- sealing rooms during times of crisis
- changing Israeli building codes to ensure each new apartment included a MMD (pronounced *mamad*, short for *Merhav Mugan Dirati* or 'secure apartment space'), a room specially designed to withstand shrapnel blast and the use of a CBW agent(118)
- deploying CW and BW detectors
- stockpiling antibiotics and vaccines
- pre-vaccinating health officials and emergency personnel ('first responders')
- equipping first responders with protective gear and decontamination equipment, and training them to deal with such contingencies

To understand the true importance of passive defense, it is important to remember that what differentiates weapons of mass destruction from conventional munitions is that they have the *potential* to kill many times more people per munition. While there is very little that can realistically be done to lessen the effects of nuclear or radiological weapons, this is not true of CBW. In fact, with the proper use of passive defense and sufficient warning, it is possible to reduce the casualty rates of CBW by as much as 95 percent.(119) CW agents, for example, are easily detected once used because they all tend to cause similar symptoms and are radically different from the organic materials of their environments. At the same time, while significantly restrictive and slightly uncomfortable, Mission Oriented Protected Posture (MOPP) suits offer nearly 100 percent protection against all CW threats. For those without MOPP suits, using gas masks can offer protection against some threats and quick application of atropine after exposure can be very effective.(120) As for BW, a standard issue protective mask offers virtually 100 percent protection against all BW threats (no MOPP suit needed as in CW defense). Antibiotics can also be used before and after infection to help treat victims, as well as treating exposed individuals with immunoglobulins. While vaccines do exist for viral BW agents, they have shortcomings, in that they require a significant amount of time before exposure to be effective, and they can be

overcome by a high dose of biological agent.(121)

That casualty rates of CBW can be greatly reduced using passive defense is especially important to bear in mind because it is CBW that are both the easiest technologically, logistically, and financially to produce, and also the easiest to produce and transport without detection.(122) This also means that when considering an attack from an enemy state (and arguably for the WMD terrorist threat as well), it is CBW that are the *more likely* threats policymakers will have to face.

With this in mind, the most obvious value of passive defense is that in the case of a chemical or biological attack, serious preparedness can greatly reduce death and injury, reducing the potential destructiveness of these weapons. Secondly, passive defenses are critical for their psychological effects. Not only does lessening the vulnerability reduce the terror that these weapons can impose, but it is incredibly important for helping calm civilian panic as well. By giving them specific things they can do to protect themselves, it gives civilians a sense of control over a situation in which they otherwise have little.(123)

Lastly, both active and passive defense have another major benefit: by reducing the potential impact of using a CW or BW, a defending country is able to increase its deterrence, as the attacking country would now stand to gain little by launching a CBW attack, while the price it would pay would remain exceedingly high. Taking this logic one step further, it is possible that deploying effective defenses would even diminish (though doubtfully extinguish) the incentive for adversaries to spend resources developing CBW agents in the first place.

In addition to its numerous benefits, passive defense can also be relatively inexpensive. Compared to the billions of dollars a country must spend on acquiring active defense, passive defense can be achieved for a fraction of the price. For example, during the 1990s, Israel spent between $50-62 million on personal protective kits, including gas masks and atropine, for each of its citizens--which is less than the cost of one year of Arrow development.(124) The one notable exception to this is changing building codes to ensure each new building includes a secure shelter or room (MMD): Israel's total annual national cost for creating MMDs in homes and public buildings is estimated to range from $125-325 million.(125)

In terms of Israel's experience with passive defense, one can point to numerous successes and occasional failures. One success has been that for several decades, Israel has equipped its military with gas masks and protective suits, nerve gas antidotes, and other defense equipment, and Israel has made training with this equipment a routine part of military exercises. Yet, at the same time, when the 1990-1 Gulf War approached, the Defense Minister and Chief of Staff were extremely reluctant to distribute this same equipment to the civilian population; this despite the extreme nervousness of the population and the fact that the army had the capability to distribute gas masks to the entire population.(126)

Still, today, Israelis are easily the most well-protected population on earth, and the government bureaucracy has become extremely efficient (especially relative to other governments) in reacting to crises and improving the level of protection for its citizens. One shining example occurred in October and November 2002 (in response to the threat of another Gulf War), as Israel conducted a program to vaccinate about 15,000 health-care workers and other first responders against smallpox, which would allow them to be protected while they treat and immunize others in the event of an attack. Equally as important, pre-vaccination would significantly help build up a supply of antibodies to the virus, as it is possible to extract them from blood of a pre-vaccinated person and then inject the antibodies into a person who has a deficient immune system. Smallpox, it should be noted, can kill between 30 to 40 percent of

unvaccinated people exposed to the disease.(127)

In what was considered by many to be a very efficient and decisive move, the Israeli government went from making the decision to nearly completing the task of vaccinating in just three months.(128) In fact, Israel had already implemented its plan while the U.S. and other countries were still in the committee process deliberating. Moreover, while Israel had in place a plan to inoculate the entire population within four days by opening vaccination clinics around the clock at 200 schools, in the U.S., the only proposal discussed was to vaccinate a half-million hospital workers, which would have been quite insufficient to implement the Center for Disease Control's own mass vaccination plan--a plan which would require 10 days for total inoculation.(129)

Besides quality of the plan and the speed with which it was implemented, the program was also considered a success because Israel managed to avoid any serious side effects amongst the vaccinated, even though the vaccine statistically kills one in a million people and causes encephalitis (swelling of the brain) in one in 300,000. This success was the result of the Health Ministry's carefully screening of those vaccinated--avoiding those on steroids, with immune deficiencies, those who have undergone an organ or bone marrow transplant, and those who were never inoculated against smallpox before. The success was also the result of the decision to minimize the numbers vaccinated. Professor Manfred Green, director of Israel's Center for Disease Control, stated that if all Israeli residents were vaccinated, then between 6-12 people could have died from the vaccine--which given that in the end there was no smallpox attack, could have been considered a high price to pay.(130)

LESSONS FOR EUROPE

Any discussion about EU counterproliferation policy must begin with the questions: what threats does the EU face at present and what threats is it likely to face in the near future? Deciding how realistic certain threats are is central to deciding what strategies to embrace in response. For example, if EU policymakers are concerned about WMD blackmail by countries like Iran or Libya, then missile defense should be critical.(131) If these threats are seen as not very serious--at least for the next 5-10 years (as most estimates seem to suggest)--then missile defense is probably an enormous waste of resources at this time.

When conducting this threat assessment, it is also important to consider what European countries' foreign policies might be. In other words, if Europe (or parts of it) are considering an active foreign policy, then it should also be concerned about potential WMD attacks on EU forces abroad. For example, while the German Army possesses about 30 PAC-2 systems in operation (and another six in storage), as the discussion above has shown, this system does not offer serious protection from a ballistic missile threat. As a result, while the current threat to EU territory may not justify acquiring active defense capabilities, an active foreign policy would likely demand a heavy immediate investment in this field.(132)

While the ballistic missile threat to Europe is quite debatable at present, the threat of WMD terrorism appears to be a clear and present danger to European security. When countering this threat, European defense cannot be based on a strategy of deterring groups like al-Qa'ida. This makes non-proliferation and intelligence gathering (and sharing) critical, as well as improved border controls and guarding of nuclear power plants, chemical plants and storage facilities, and nuclear research facilities--the latter of which are neglected more often than is realized.(133) Given the EU's quickly expanding borders, stepping up these measures will become a serious challenge for the Union over the next decade. Likewise, the EU has every interest in supporting the U.S. Department of Defense's Counterproliferation Threat Reduction Program.

In this regard, Europe also has two options not available to Israel. First, as the Iranian case has demonstrated, Europe can engage in aggressive diplomacy in order to forestall WMD proliferation. Though, as the Iranian case has demonstrated, potential proliferants will not take Europe seriously unless it backs up its diplomacy with the realistic threat of painful action. Second, while Israel is not a signatory to any non-proliferation regime, all of Europe is, and thus can continue to work towards strengthening non-proliferation treaties, regimes, and especially enforcement--this is most critical for the biological weapons convention.

Less obvious for EU policymakers is that Europe should already be exploring passive defense measures. This could mean considering an EU-wide stockpiling of antidotes like atropine and antibiotics, as well as personal gas masks, and preparing the groundwork for future vaccinations of first responders and medical personnel. For instance, the EU should begin conducting preliminary studies on the feasibility and cost-benefit of such programs, and even begin creating contingency plans for their implementation in the case of emergency. It also means training and equipping first responders to deal adequately with such an attack. Especially because of its size, the EU could take these measures for relatively little cost per person.

Investing in these types of passive defense is prudent even if EU policymakers were to see no direct security threats at present. It is crucial because in the current era of massive international travel and immigration, it is no longer sufficient to ensure the defense of one's borders in order to ensure the defense of its citizens. For instance, when SARS broke out in East Asia, it quickly spread to cities as far away as Toronto. Therefore, should a biological agent (for instance, smallpox) be used against a distant country, it might have a serious impact on the EU as well.

At the same time, given the threats facing the EU today, there is probably little point in investing in expensive passive defense (such as changing building codes) or in developing an active defense program. Especially because as time goes on, American and Israeli engineers will continue to develop the technology, and should the time come where the EU would need it, European countries will most likely be able to buy the most up-to-date defensive systems from those two countries. With this in mind, Germany and Italy should not be too concerned about the early death of the Medium Extended Air Defense System (MEADS) missile defense project. Nor should the EU begin investing in a continental missile defense similar to the national missile defense being planned by the United States. In fact, most EU countries have no need for a national missile defense of the sort planned by the U.S., but could suffice with TMD systems like THAAD or the Arrow, which have footprints of over a hundred kilometers in diameter.(134) For example, the U.S. Department of Defense estimated that--depending on how many radars were used--by deploying four to six THAAD batteries, they would be able to protect all of Japan from any North Korean attack (versus an estimated 100 PAC-3 systems).(135) Most European countries could make do with a similar number of missile batteries.

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NOTES

1. In this paper, non-proliferation refers to the policies and efforts aimed at stopping other countries from acquiring WMD, and counter-proliferation refers to the policies

enacted to oppose the potential use of WMD.

2. This will not go into great detail as a detailed threat assessment would require a paper all its own.

3. Calculated according to statistics provided by the Israeli Central Bureau of Statistics <http://www.cbs.gov.il/population/new_2003/tab_1.pdf>.

4. Gerald M. Steinberg, "Israeli Responses to the Threat of Chemical Warfare," Armed Forces and Society, Vol. 20, No. 1 (Fall 1993), pp. 85-101. <http://faculty.biu.ac.il/~steing/arms/chem.htm>

5. Brigadier General Michael Herzog, "The Israeli Perception of Missile Defense," in Roger Weissinger-Baylon and Anne D. Baylon, Proceedings from the XVIth International Workshop On Political-Military Decision Making in the Atlantic Alliance, Hungarian National Parliament, Budapest, Hungary 20-23 June 1999 (Menlo Park, California: Center for Strategic Decision Research, 2000). <http://www.csdr.org/99Book/1999_chap28.htm>

6. While Iraq's fixed missile launchers were destroyed within the first few minutes of the 1991 Gulf War, the mobile launchers managed to elude coalition forces for most of the war. Dean A. Wilkening, "Ballistic-Missile Defence and Strategic Stability," Adelphi Paper Vol. 334 (New York: Oxford University Press, 2000), p. 88 note 14.

7. Carnegie Analysis, "Summary of Syria's Chemical and Biological Weapons Programs," April 15, 2003 <http://www.ceip.org/files/nonprolif/templates/article.asp?NewsID=4671> and Robert Wall and David Fulghum, "Arrow Fielding Slows as Threat Increases," Aviation Week and Space Technology, June 24, 2002, p. 85.

8. Center for Nonproliferation Studies resource page on Egypt <http://www.cns.miis.edu/research/wmdme/egypt.htm>.

9. While the CSS-2 has a long range, its liability is that it is fired from a fixed launch site, greatly increasing its vulnerability to a counterforce strike. Center for Nonproliferation Studies resource page on Saudi Arabia <http://www.cns.miis.edu/research/wmdme/saudi.htm>. Wilkening puts the maximum number of missiles at 120, see Wilkening, "Ballistic-Missile Defence and Strategic Stability," p. 79.

10. Center for Nonproliferation Studies resource page on Saudi Arabia <http://www.cns.miis.edu/research/wmdme/saudi.htm>. While it does not currently have any known programs, OC Intelligence Maj.-Gen. Aharon Ze'evi has claimed that the country approached Pakistan about the possibility of acquiring a nuclear weapon--a claim supported by a Pakistani source. Considering the discovery of the extent of Pakistani proliferation activities in January 2004, these reports should be taken seriously. See Jerusalem Post, October 22, 2003; Washington Times, October 22, 2003; Ha'aretz, October 23, 2003; NYT, January 4, 6, and February 21, 2004.

11. See, for example, the page on Libya's WMD program at the Center for Nonproliferation Studies site <http://www.cns.miis.edu/research/wmdme/libya.htm>

12. Reuters, October 14, 2003. The quotation is an indirect one given by an unidentified aid.

13. Wall and Fulghum, "Arrow Fielding Slows as Threat Increases," p. 85.

14. The most interesting aspect of the Libyan confession regarding its nuclear weapons program was not that it was heavily dependent on foreign supply of know-how and material, but the degree to which this was the case. In terms of a weapon design, for instance, while Libya had purchased one from a foreign supplier, Libya apparently had "no national personnel competent to evaluate the [design] and would have asked the supplier for help in the event it had opted to take further steps to develop a nuclear weapon." See the IAEA director general's report on Libya, Implementation of the NPT Safeguards Agreement of the Socialist

People's Libyan Arab Jamahiriya, February 20, 2004, p. 6 <http://www.fas.org/nuke/guide/libya/iaea0204.pdf>.

15. By the time Iraq invaded Kuwait during the summer of 1990, it had established an extensive nuclear program, at a cost of approximately $8-11 billion, employing approximately 7,000 scientists and 20,000 technicians. Shai Feldman, Nuclear Weapons and Arms Control in the Middle East (Cambridge: The MIT Press, 1997), p. 53; Shahram Chubin, Eliminating Weapons of Mass Destruction: The Persian Gulf Case (Washington, DC: Henry L. Stimson Center, 1997), p. 15.

16. Especially if they already had a warhead design. Author's interview with Pentagon source (Alexandria, VA, January 21, 1998); Chubin, Eliminating Weapons of Mass Destruction, p. 16; and Feldman, Nuclear Weapons and Arms Control, p. 53.

17. It also admitted producing botulin toxin (19,000 L), aflatoxin (2,200 L), gas gangrene, wheat cover smut, ricin, haemorrhagic conjunctive virus, and rotavirus. These numbers were used by various military and media sources throughout the years, and many given again by Hans Blix (former UNMOVIC chairman) in his report to the U.N. Security Council on Iraq, January 27, 2003. Some examples include: George J. Tenet, Testimony before the Senate Armed Services Committee, March 19, 2002. <http://www.cia.gov/cia/public_affairs/speeches/senate_select_hearing_03192002.html>, accessed October 2003; Department of Defense, Proliferation: Threat and Response, pp. 38-42; "A Sick Inventory," Economist, April 12, 1997; Arieh O'Sullivan, "Saddam, Again, Pushes the Envelope," Jerusalem Post, February 6, 1998.

18. Stockholm International Peace Research Institute, SIPRI Yearbook 1997: Armaments, Disarmaments and International Security (New York: Oxford University Press, 1997), p. 458; Amos Harel, "Butler: Saddam could destroy Tel Aviv," Ha'aretz, January 28, 1998.

19. "Report: Iraq Hiding Weapons," Associated Press, January 27, 1998.

20. Chubin, Eliminating Weapons of Mass Destruction, p. 17; and O'Sullivan, "Saddam, Again, Pushes the Envelope."

21. Baghdad Domestic Service in Arabic, broadcast 10:30am, April 2, 1990; found in Ofra Bengio (ed.), Saddam Speaks on the Gulf Crisis: A Collection of Documents (Tel Aviv: Tel Aviv University, 1992), pp. 55, 60.

22. BIAF--Israel Aviation and Space Magazine (Hebrew), No. 72 (Spring 1991), p. 31, as quoted by Postol in Robert M. Stein & Theodore Postol, "Correspondence: Patriot Experience in the Gulf War," International Security, Vol. 17, No. 1 (Summer 1992), p. 232, note 19. On the number of Scuds that actually hit populated areas, see Uzi Rubin, "Meeting the 'Depth Threat' from Iraq: The Origins of Israel's Arrow System," Jerusalem Issue Brief, Vol. 2, No. 19 (March 5, 2003) <http://www.jcpa.org/brief/brief2-19.htm>.

23. See Marshall Breit, "Iran's Programs to Produce Plutonium and Enriched Uranium," Carnegie Non-Proliferation Project, updated December 1, 2003 <http://www.ceip.org/files/projects/npp/resources/Factsheets/iransnuclearprogram.htm>; as well as U.S. Undersecretary for Arms Control and International Security John R. Bolton, "The New World After Iraq: The Continuing Threat of Weapons of Mass Destruction," October 30, 2003 <http://www.state.gov/t/us/rm/25752.htm>.

24. Ha'aretz, October 13, 2003.

25. SIPRI Yearbook 1997, p. 462; Leonard S. Spector, "Nuclear Proliferation in the Middle East: The Next Chapter Begins," in Efraim Karsh, Martin S. Navias, and Philip Sabin (eds.) Non-Conventional-Weapons Proliferation in the Middle East (New York: Oxford University Press, 1993); and R. Jeffrey Smith, "Chinese Firms Supply Iran With Gas Factories, U.S. Says," Washington Post, March 8, 1996.

26. Department of Defense, Proliferation: Threat and Response, January 2001, p. 36 <http://www.defenselink.mil/pubs/ptr20010110.pdf>

27. Amir Oren, "New Iranian missile threat worries Israel," Ha'aretz, July 4, 2003; Central Intelligence Agency, "Unclassified Report to Congress on the Acquisition of Technology Relating to Weapons of Mass Destruction and Advanced Conventional Munitions," from January 1-June 30, 2003, released November 10, 2003 <http://www.ceip.org/files/nonprolif/templates/article.asp?NewsID=5621>; and Wilkening, "Ballistic-Missile Defence and Strategic Stability," p. 77.
28. Wall and Fulghum, "Arrow Fielding Slows as Threat Increases," p. 85; Oren, "New Iranian missile threat worries Israel;" and "Iran warns its missiles can hit anywhere in Israel," Reuters, August 15, 2004.
29. As the Pentagon's own report concludes, "Iran recognizes that it cannot match U.S. military power and therefore seeks other asymmetric means to challenge the United States. . . [including] the acquisition and development of NBC weapons and missiles. . . which it views as a means to offset its own vulnerabilities and weaknesses." Proliferation: Threat and Response, p. 34. See also Lieutenant General Patrick M. Hughes, U.S. Army, Director, Defense Intelligence Agency, "Global Threats and Challenges: The Decades Ahead," Prepared Statement before the Senate Armed Services Committee, Washington, D.C., February 2, 1999.
<http://www.defenselink.mil/speeches/1999/s19990202-hughes.html>
30. Ha'aretz, April 13, 2004. Over the years, there also have been several instances of Palestinians attempting to poison Israelis' food, either in restaurants or in the produce they shipped.
31. Al-Manar, August 13, 2001, translated by MEMRI, Special Dispatch Series, No. 255 (August 14, 2001).
32. In September 1984, the Rajneeshee (a religious cult) contaminated the salad bars of local restaurants with salmonellas. As a result 751 people became ill, but no one died. In 2001, there were several instances of anthrax being sent in the mail, but here as well, there were only 18-22 infected and five deaths. Ely Karmon, "Are the Palestinians Considering Biological Weapons?" ICT website, August 14, 2001 <http://www.ict.org.il/articles/articledet.cfm?articleid=376>. On the 2001 anthrax attacks, see "FBI Renews Search In Anthrax Probe," CBS News.com, Dec. 12, 2002
<http://www.cbsnews.com/stories/2002/09/04/national/main520719.shtml>
33. Karmon, "Are the Palestinians Considering Biological Weapons?"
34. Nic Robertson, "Tapes shed new light on bin Laden's network," CNN website, August 19, 2002 <http://www.cnn.com/2002/US/08/18/terror.tape.main/>.
35. John Hamre, "Nuclear, Biological, and Chemical Weapons Terrorism: Assessing Risks and Crafting Responses," in Michael Barletta (ed.), WMD Threats 2001: Critical Choices for the Bush Administration (Monterey, CA: Center for Nonproliferation Studies, 2001), p. 25.
36. Reuven Pedatzur, "Playing Dirty," Ha'aretz, June 22, 2003.
37. Steinberg, "Israeli Responses to the Threat of Chemical Warfare."
38. Aluf Benn, "Israel, Iran and the nuclear bomb," Ha'aretz, October 12, 2003.
39. See Washington Post, November 6, 1980, and especially the French reaction to the Iraqi decision.
40. Statement by the Government of Israel on the Bombing of the Iraqi Nuclear Facility near Baghdad, June 8, 1981 <http://www.mfa.gov.il/mfa/go.asp?MFAH0i5s0>.
41. See for instance, Der Spiegel, October 11, 2003.
42. Yitzhak Rabin, "Deterrence in an Israeli Security Context," in Aharon Klieman and Ariel Levite (eds.), Deterrence in the Middle East: Where Theory and Practice Converge (Tel Aviv: Jaffee Center for Strategic Studies, 1993), pp. 9-10.
43. CNS, "Israel: Weapons of Mass Destruction Capabilities and Programs" <http://www.cns.miis.edu/research/wmdme/israel.htm>; Stockholm International Peace

Research Institute, SIPRI Yearbook 2003: Armaments, Disarmament and International Security (NY: Oxford Univ. Press, 2003), p. 617; on the Jericho-2, see Harold Hough, "Could Israel's nuclear assets survive a pre-emptive strike?" Jane's Intelligence Review, September 01, 1997 <http://www.janes.com/regional_news/africa_middle_east/news/jir/jir990901_1_n.shtml>.

There is additionally some speculation that Israel may also have non-strategic nuclear weapons as well, including nuclear artillery shells and landmines. See SIPRI, SIPRI Yearbook 2003, p. 617.

44. See, for instance Los Angeles Times, October 11, 2003; Ha'aretz, October 12, 2003; and subsequent denials by former deputy minister of defense Efraim Sneh, Ha'aretz, October 13, 2003.

45. Rabin in FBIS-NEA, July 21, 1988, pp. 28-9, cited by Eisenstadt, Sword of the Arabs, p. 54 and Steinberg, "Israeli Responses to Chemical Warfare."

46. Hough, "Could Israel's nuclear assets survive a pre-emptive strike?"

47. Yair Evron, "Deterrence Experience in the Arab-Israeli Conflict," in Aharon Klieman and Ariel Levite (eds.), Deterrence in the Middle East: Where Theory and Practice Converge (Tel Aviv: Jaffee Center for Strategic Studies, 1993), p. 114.

48. John Harvey is right to point out that strike aircraft actually have many advantages over ballistic missiles (even for the delivery of chemical weapons), including reliability, payload capability, ability to locate moving targets, accurate delivery, and damage assessment. Yet for a country such as Israel, whose air defense system is extremely capable (and whose adversaries air forces are mediocre), it is highly unlikely that Israel's enemies' strike aircraft will reach their intended targets, in which case, all other advantages become worthless. Harvey's point actually is more relevance for a country like Israel and its ability to deliver munitions against its adversaries. See John R. Harvey, "Regional Ballistic Missiles and Advanced Strike Aircraft: Comparing Military Effectiveness," International Security, Vol. 17, No. 2 (Autumn 1992).

49. "Customs Seizes Radioactive Uranium at Rousse Check Point," FBIS, 29 May 1999, cited by Department Of Defense, International Counterproliferation Program, "Success Stories: Impact of the ICP Program on Proliferation" <http://www.dtra.mil/Toolbox/Directorates/OSI/Programs/icp/success.cfm>. The site notes several other successes: In April 2001, Kazakh border guards found two containers with lead coating emitting considerable radiation in a train bound for China. In April 2000, Uzbek customs officials seized ten radioactive containers. And in June 1998, Bulgarian customs officials stopped a shipment of equipment for a nuclear reactor, which appeared destined for Iran.

50. On biometrics, see Yona Flink, "The Israeli Border Crossing Project" SecurityInnovator.Com, September 6, 2002 <http://www.technologyreports.net/securefrontiers/?articleID=545>.

51. As for anti-ballistic missile programs, it is interesting to note that they were not born in response to a Middle Eastern rogue state, nor were begun as part of the Reagan Administration's Strategic Defense Initiative (SDI or "Star Wars" program), but rather in response to European conflict. In 1945, in response to the German V-2 ballistic missile attacks against London, American scientists began to consider the possibility of using both high-powered lasers and missiles to defend against the new threat. Sixty years later, scientists and engineers continue to pursue these two methods--only now these technologies are no longer science fiction.

52. This includes the Hawk, Medium Extended Air Defense System (MEADS), Navy Area Defense (NAD), Theater High-Altitude Area Defense (THAAD), and Navy Theater Wide (NTW). However, many of these systems--like HAWK and Patriot--were originally designed as anti-aircraft systems, and only became anti-missile as an after-thought. Tactical High Energy Laser (THEL), which uses a laser,

is meant to knock down tactical rockets mid-flight.

53. Theodore Postol, "Lessons of the Gulf War Experience with Patriot," International Security, Vol. 16, No. 3 (Winter 1991/2), pp. 124-5.

54. 158 Patriots were fired at 47 Scuds, and 39 other Scuds were not engaged as they were outside the Patriot perimeter or the impact was anticipated to occur in an area where damage would be minimal.

55. Bob Davis, "Patriot Missile, High-Tech Hero in Gulf, Comes Under Attack as Less than Scud's Worst Enemy," Wall Street Journal, April 15, 1991 as cited by Postol, "Lessons of the Gulf War," p. 134. Number of Israeli intercepts given by Postol, p. 135.

56. The Army also added that it had lower confidence in warhead kills in another 27 percent of engagements, however, the evidence of these kills is quite poor. United States General Accounting Office, "Operation Desert Storm: Data does not Exist to Conclusively say How Well Patriot Performed," Report to Congressional Requesters, September 22, 1992, p. 2. <http://www.fas.org/spp/starwars/gao/b250335.htm> Theodore Postol and George Lewis scrutinized all available video and came to an even more pessimistic conclusion: "We found no convincing evidence in the video that any Scud warhead was destroyed by a Patriot. We have strong evidence that Patriots hit Scuds on two occasions, but in both cases the videos also show that the Scud warheads fell to the ground and exploded. These clips provide strong evidence that even when Patriots could hit Scuds they were still not able to destroy Scud warheads." Theodore Postol, "Letter to Congressman John Conyers Jr., Chairman of the Committee on Government Relations." Dated September 8, 1992, published in Inside the Army October 5, 1992, p. 10. <http://www.fas.org/spp/starwars/docops/pl920908.htm>

57. While Raytheon (the Patriot's manufacturer) continued to maintain that the system was highly effective, and cited classified (and thus unchallengeable) Army assessments as proof, these assessments were in large part based on ground damage assessments that were not coordinated and frequently relied on interviews with Saudi nationals to determine the extent of the damage. For Raytheon's assessment, see Stein & Postol, "Correspondence: Patriot Experience in the Gulf War," p. 211. For how these assessments were conducted, see United States General Accounting Office, "Operation Desert Storm: Data does not Exist to Conclusively say How Well Patriot Performed," Report to Congressional Requesters, September 22, 1992, p. 3-8, esp. 7-8. <http://www.fas.org/spp/starwars/gao/b250335.htm>

58. Postol argues, for instance, the fact that the first 13 Scuds that fell on Tel Aviv and Haifa--which were unopposed by Patriot missile batteries because they were not yet operational--damaged 2,698 apartments and wounded 115 people. After the Patriot began engaging the Scuds, there were 14-17 attacks which hit those same cities, but now damaged 7,778 apartments, 168 people were wounded, and one person was killed as a direct result of the attacks, most likely by a Patriot missile. Postol, "Lessons of the Gulf War," pp. 124, 140. However, Uzi Rubin, head of the Arrow project would later state that only 8 of the 40 missiles fired (his total count is one more than Postol's) landed in densely populated areas. This means that the difference in damage could simply have been caused by more Scuds having hit their targets than the first 13 fired; thus, Postol's claim in this instance must be viewed with caution.

59. Postol, "Lessons of the Gulf War," p. 133.

60. Theodore Postol, "Letter to Congressman John Conyers Jr., Chairman of the Committee on Government Relations." Dated September 8, 1992, published in Inside the Army, October 5, 1992, p. 10. <http://www.fas.org/spp/starwars/docops/pl920908.htm>

61. Postol, "Lessons of the Gulf War," p. 126. Postol notes that it is the only rocket

he is aware of besides the V-2 that uses fins and jet vanes for stabilization during powered ascent.
62. Ibid., p. 127.
63. Ibid., pp. 132, 155-6.
64. Ibid., p. 146.
65. Ibid., p. 153.
66. Ibid., pp. 148-50.
67. Ibid., p. 146.
68. Ibid., p. 155.
69. Stein & Postol, "Correspondence: Patriot Experience in the Gulf War," pp. 208-11.
70. Ibid., p. 214.
71. What the other upgrades included is a matter of some debate, but it has been said to include: software adjustments to raise the interceptor's minimum intercept altitude; changes to the battle management functions; corrections to deal with false targets generated by radar reflections off buildings; changes to the Scud ballistics model; and changes to the interceptor guidance parameters. Postol, "Lessons of the Gulf War," notes 82 and 83. Stein disputes this, claiming without saying so explicitly, that it was the Scud missile's breaking apart that these software upgrades were meant to repair. See Stein & Postol, "Correspondence: Patriot Experience in the Gulf War," p. 215.
72. Postol, "Lessons of the Gulf War," p. 157.
73. Federation of American Scientists website <http://www.fas.org/spp/starwars/program/patriot.htm> and <http://www.fas.org/spp/eprint/act_bmd.htm>.
74. Lockheed-Martin's press release, found on PR Newswire, October 22, 2001 <http://www.prnewswire.com/cgi-bin/stories.pl?ACCT=104&STORY=/www/story/03-21-2002/0001691837&EDATE=>.

THAAD tests in June and August 1999, as well as the first NMD interceptor in October 1999--both of which also use hit-to-kill warheads--were also successful. Wilkening, "Ballistic-Missile Defence and Strategic Stability," pp. 25, 90 note 35.
75. Wilkening, "Ballistic-Missile Defence and Strategic Stability," p. 46; Federation of American Scientists website <http://www.fas.org/spp/starwars/program/patriot.htm> and <http://www.fas.org/spp/eprint/act_bmd.htm>.
76. The breakdown of costs is $9.6 billion for all planned purchases of Patriot missiles, $490 million for modifications and $335 million for product improvements. Wilkening, "Ballistic-Missile Defence and Strategic Stability," p. 46; and Federation of American Scientists website <http://www.fas.org/spp/starwars/program/patriot.htm>
77. Ha'aretz, December 14, 2002; and John J. Miller, "Israel's Arrow Defense," National Review, October 15, 2002 <http://www.nationalreview.com/miller/miller101502.asp>.
78. Amnon Barzilai, "An Arrow to the heart," Ha'aretz, November 16, 2002.
79. Michael R. Gordon, "Israel Set to Use New Missile Shield to Counter Scuds," New York Times, October 6, 2002.
80. Robert Wall and David Fulghum, "Arrow Fielding Slows as Threat Increases," Aviation Week and Space Technology, June 24, 2002, p. 85.

One potential problem with the Arrow is that it uses a proximity fuse warhead similar to the PAC-2, instead of a hit-to-kill like the PAC-3. Arieh O'Sullivan, "Arrow-2 missile test a success," Jerusalem Post, July 28, 2004.
81. Barzilai, "An Arrow to the heart."
82. Amos Harel, "Israel, U.S. conduct successful test of Arrow missile," Ha'aretz, July 30, 2004; Ha'aretz Service, "Top defense officer: Israel can meet threat of Iran's Shihab-3" Ha'aretz, July 8, 2003.
83. Amnon Barzilai, "Defense official: Arrow can intercept Shihab-3," Ha'aretz, August 27, 2004.
84. Barzilai, "An Arrow to the heart."
85. A third battery will be deployed in the south by 2005.
86. Barzilai, "An Arrow to the heart."
87. Federation of American Scientists website <http://fas.org/spp/starwars/program/arrow.

htm>; and Ha'aretz, May 04, 2003.
88. Duncan Clarke, "The Arrow Missile: The United States, Israel, and Strategic Cooperation," Middle East Journal, Vol. 48, No. 3 (Summer 1994), pp. 476, 478.
89. Ibid.; and Barzilai, "An Arrow to the heart."
90. A "more realistic" estimate of $5-7 billion is used by Clarke in his "The Arrow Missile," p. 483. However, by 2002, the total costs had remained as projected. See Barzilai, "An Arrow to the heart." As of July 2004, the development costs had reached $2.2 billion, though this additional cost was largely due to the fact that development of the system continued, as they have continued to improve and test the system. Amos Harel, "Israel, U.S. conduct successful test of Arrow missile."
91. For these arguments and a general critique of U.S. involvement in the Arrow project, see Clarke, "The Arrow Missile."
92. Ibid., p. 479.
93. Steve Rodan, "Arrow missile intercepts incoming target," Jane's Defense Weekly, September 18, 2000.
94. Gordon, "Israel Set to Use New Missile Shield to Counter Scuds"; Uzi Rubin, "Meeting the 'Depth Threat' from Iraq: The Origins of Israel's Arrow System," Jerusalem Issue Brief, Vol. 2, No. 19 (March 5, 2003) <http://www.jcpa.org/brief/brief2-19.htm>; Barzilai, "An Arrow to the heart"; and Amnon Barzilai, "Arrow anti-missile destroys high-altitude test target," Ha'aretz, December 16, 2003.
95. Arieh O'Sullivan, "Arrow-2 missile test a success"; Harel, "Israel, U.S. conduct successful test of Arrow missile."
96. Wilkening, "Ballistic-Missile Defence and Strategic Stability," p. 48.
97. Gordon, "Israel Set to Use New Missile Shield to Counter Scuds."
98. See, for instance, Reuven Pedatzur, "The Damaging Effect of the Arrow's Success," Ha'aretz, February 4, 2002.
99. Gordon, "Israel Set to Use New Missile Shield to Counter Scuds."
100. Barzilai, "An Arrow to the heart."
101. Wilkening, "Ballistic-Missile Defence and Strategic Stability," p. 52.
102. Ibid.
103. These arguments were both made by Uzi Rubin. See Barzilai, "An Arrow to the heart."
104. Pedatzur, "The Damaging Effect of the Arrow's Success."
105. John Pike and Peter Voth, "Current Plans for Missile Defense," Disarmament Forum, United Nations Institute for Disarmament Research, January 2001, p. 5 <http://fas.org/spp/starwars/program/news01/1-01-epike.pdf>.
106. Creating such countermeasures is not very straightforward either. For instance, most of the more basic radar decoys would not survive re-entry into the atmosphere. Wilkening, "Ballistic-Missile Defence and Strategic Stability," pp. 25-7, 46.
107. Barzilai, "An Arrow to the heart"; Pedatzur, "The Damaging Effect of the Arrow's Success"; and Postol, "Lessons of the Gulf War," p. 162.
108. Wilkening, "Ballistic-Missile Defence and Strategic Stability," p. 59; the Federation of American Scientists website <http://fas.org/spp/starwars/program/bpi.htm>; and Pike and Voth, "Current Plans for Missile Defense," pp. 5-6.
109. The first non-ABM compliant test of the space-based laser is scheduled only for 2013. Wilkening, "Ballistic-Missile Defence and Strategic Stability," p. 60.
110. Wilkening, "Ballistic-Missile Defence and Strategic Stability," p. 63.
111. Pike and Voth, "Current Plans for Missile Defense," pp. 5-6.
112. However, his calculations are based on a much faster interceptor. Also, he uses the No-Dong instead of the Shihab-3, but the two have similar ranges and booster technology, making the comparison relevant. Wilkening, "Ballistic-Missile Defence and Strategic Stability," pp. 61-2.
113. Ibid., p. 62.
114. Ibid., p. 65.
115. Ibid., pp. 65-7.
116. Ibid., pp. 65, 67.
117. Ibid., p. 65; and Pike and Voth, "Current Plans for Missile Defense," pp. 5-6.

118. The building codes were changed in 1992. For apartments, MMDs are required to have external concrete walls with a width of 30cm and interior walls, ceilings, and floors made of concrete with a width of 15-20cm. In addition, the rooms' windows must have blast shields and must have a special door. David Klein, Hitgonnenut HaOref: Bichinat HaHashka'ah HaLeumit (Hebrew, "Protecting the Homefront: Considering the National Investment") (Tel Aviv: Jaffee Center, April 2001), p. 30.
119. One Scud missile with a chemical warhead hitting an urban area is likely to kill 60-100 people if the population is unprotected, but only 5-10 if they are protected by passive measures. If 20 Scuds are used, the numbers are 1400-1800 versus 120-170, respectively. Klein, Hitgonnenut HaOref, pp. 25-6. Klein cites Lord Lyell, Chemical and Biological Weapons: The Poor Man's Bomb, North Atlantic Assembly Draft General Report, AN 253 / STC (96) 8, October 4, 1996.
120. Also, in order to be very effective, there must be a continual bombardment of chemical weapons, thus reducing the utility of a single warhead or terrorist bomb. Matthew Meselson, "Implications of the Kuwaiti Crisis for Chemical Weapons Proliferation and Arms Control," Chemical Weapons & Security in the Middle East (Washington, DC: AAAS, 1990), pp.15, 22.
121. Robert P. Kadlec, Biological Weapons in the Post-Cold War Era. Unpublished., pp. 6, 10.
122. The gap in difficulty occurs on almost every level. With $10 million, one small room with an industrial-size fermentor, 1 or 2 trained experts, and 2ml of biological agent seed stocks can produce significant biological weapons. Chemical weapons can be produced with a similar amount of money, chemical precursors found in industry, a two-room apartment, and a handful of moderately trained personnel. To produce nuclear weapons, however, requires hundreds of well-trained scientists and technicians, a large quantity of fissile material, a complex bomb design, tens of billions of dollars, huge, expensive equipment that has little other purpose and is relatively easily tracked, and at a minimum, a laboratory the size of a warehouse. In addition, clandestine nuclear weapons programs are difficult to hide because nuclear sites often leak radioactivity which can be easily detected from a considerable distance and for a considerable length of time.
123. Along these lines, I would argue that during the 2003 war in Iraq, when many Israelis decided not to carry their masks with them as they went along their business, they had to make a decision that the threat was not imminent, and thus they need not be too overly anxious about it.
124. Klein, Hitgonnenut HaOref, p. 30; Barzilai, "An Arrow to the heart." Another media report claimed that Israel had spent 2 billion shekels (approximately $450 million) between 1990-2003 on gas masks, and that to maintain them in the hands of the public would cost another 200 million shekels a year ($45 million). As a result, and as a result of a lowered threat assessment after Saddam's regime ended, the Israeli Army has apparently decided to collect the gas masks and store them in army warehouses. AP, February 15, 2004, citing an Israeli Channel 2 news report. It is worth noting that only one month earlier, the IDF had announced it would be replacing the standard black gas masks Israelis had been given with a newly designed sapphire one. However, a serious disagreement existed between the head of the Homefront Command and the IDF's chief medical officer, Brigadier General Hezi Levy, who refused to approve the change, claiming that a medical corps panel disqualified use of the Even Sapir model unless it is outfitted with a special exhalation tube to forestall carbon dioxide build up. Amnon Barzilai, "Despite Medical Opposition, IDF to Replace Gas Masks," Ha'aretz, January 19, 2004.
125. The numbers Klein gives are actually 500 million-1.3 billion shekels. In 2001 when the monograph was published, the exchange rate was roughly 4 shekels to the

dollar. As for a breakdown of the cost, each new apartment had an additional cost of 5,000-20,000 shekels ($1,250 to $5,000), and the total expenses on public buildings was about 45 million shekels ($11.25 million) a year. Klein, Hitgonnenut HaOref, pp. 32-7.

126. The army stated that it had acquired the necessary supplies as early as 1981. Steinberg, "Israeli Responses to the Threat of Chemical Warfare."

127. Jackie Northam and Richard Knox, "Profile: Smallpox Preparedness Of Israel And The U.S." NPR's All Things Considered, November 1, 2002 <http://www.npr.org/programs/atc/transcripts/2002/nov/021101.northam.html>; Elizabeth Cohen, "Israel gives smallpox vaccines--should U.S.?" CNN, November 20, 2002 <http://www.cnn.com/2002/HEALTH/11/20/smallpox.israel/>.

128. Cohen, "Israel gives smallpox vaccines."

129. Amazingly, the U.S. plan did not even include immunizing those who would give future immunization shots themselves. Northam and Knox, "Smallpox Preparedness Of Israel And The U.S."

130. Northam and Knox, "Smallpox Preparedness Of Israel And The U.S."; Cohen, "Israel gives smallpox vaccines."

131. There are those who think Europe should deal seriously with this threat. Herzog, for instance, stated in 1998, "Not so long ago, we must remember, it was Qadhafi who threatened to use his missiles against the southern flank of NATO." He then continued to suggest that Iran's development of the Shihab-5 missile, with a range of 4,000-6,000km, "could reach deep into the heart of Europe. One must ask: 'Why do the Iranians want missiles with such ranges?'" While I concur that the Shihab-5 should trouble EU policymakers, it is highly unlikely the missile will be ready in the near- or medium-term. Herzog, "The Israeli Perception of Missile Defense."

132. Ha'aretz, December 2, 2002.

133. Even two years after the September 11 attacks, the U.S. had still not properly secured the 15,000 facilities across the country that produce or store deadly chemicals, including the more than 100 chemical plants where a catastrophic accident or an act of sabotage by terrorists could endanger more than a million people. Steve Kroft, "U.S. Plants: Open To Terrorists," CBS News, 60 Minutes, November 14, 2003 <http://www.cbsnews.com/stories/2003/11/13/60minutes/main583528.shtml>.

134. Wilkening, "Ballistic-Missile Defence and Strategic Stability," p. 53.

135. Department of Defense, Report to Congress on Theater Missile Defense Architecture Options for the Asia-Pacific Region (May 1999) <http://fas.org/spp/starwars/program/tmd05 0499.htm>.